Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of the claims:

1. (currently amended): A method of conditioning a planarizing surface in a chemical mechanical polishing (CMP) apparatus having a polishing pad against which a wafer is positioned for removal of material therefrom and a conditioning disk is positioned for conditioning of the polishing pad, comprising the steps of:

a) providing a pad wear and conditioning model that defines wafer material removal rate as a function of at least one pad conditioning ~~parameters~~ parameter selected from the group including rotation speed ~~and/or~~ and rotation direction of a conditioning disk;

b) polishing a wafer in ~~the~~ a CMP apparatus under a first set of pad conditioning parameters selected to maintain wafer material removal rates within preselected minimum and maximum removal rates;

c) determining a wafer material removal rate occurring during said polishing step; and

d) calculating updated pad conditioning parameters based upon said determined wafer material removal rate of said step (c) and the pad wear and conditioning model of said step (a). ~~and~~

~~e) conditioning the polishing pad using the updated conditioning parameters.~~

2. (original): The method of claim 1, wherein step (d) includes calculating updated pad conditioning parameters to maintain wafer material removal rate within the maximum and minimum removal rates.

3. (original): The method of claim 1, wherein the first set of pad conditioning parameters are determined empirically.

4. (original): The method of claim 1, wherein the first set of pad conditioning parameters are determined using historical data.

5. (original): The method of claim 1, wherein the first set of pad conditioning parameters are determined using the results of the design of experiment (DOE).

6. (currently amended): The method of claim 1, wherein the pad conditioning parameter ~~parameters~~ of the pad wear and pad recovery model further comprises a conditioning parameter selected from the group consisting of frequency of conditioning, duration of conditioning, and translational speed of conditioning disk during conditioning.

7. (canceled).

8. (currently amended): The method of claim 1, wherein the updated pad conditioning parameters are calculated by determining the difference between an output of the pad wear and conditioning model and said determined wafer material removal rate of step (c).

9. (original): The method of claim 8, wherein said difference is adjusted using an estimate gain prior to calculating updated conditioning parameters.

10. (original): The method of claim 9, wherein the gain is selected to represent variability or reliability in the measured parameter.

11. (original): The method of claim 1, wherein the updated pad conditioning parameters are updated according to the equation $k = (k_1) + g * (k - (k_1))$, where k is a measured wafer material removal rate, k_1 is a calculated wafer material removal rate, g is the estimate gain, and $(k-(k_1))$ is the prediction error.

12. (original): The method of claim 1, wherein the steps (b) through ~~(e)~~ (d) are repeated.

13. (original): The method of claim 1, wherein the step of calculating updated pad conditioning parameters in step (d) comprises executing a recursive optimization process.

14. (original): The method of claim 1, wherein the maximum value for wafer material removal rate is the saturation point of the wafer material removal rate vs. conditioning down force curve.

15. (original): The method of claim 1, wherein the maximum value for wafer material removal rate is the initial rate.

16. (original): The method of claim 1, wherein the minimum value for wafer material removal rate is defined by the maximum acceptable wafer polishing time.

17. (original): The method of claim 1, wherein the wafer material removal rate is defined by the equation

$$\mathrm{Re}\,movalRate\Big]_{\min}^{\max} = f(\omega_{disk}\Big]_{\min}^{\max}, f\Big]_{\min}^{\max}, t_{conditioning}\Big]_{\min}^{\max}, direction, T_2\Big]_{\min}^{\max}\Big),$$

where ω_{disk} is the angular velocity of the conditioning disk during conditioning of the polishing pad, t is the time of conditioning, f is the frequency of condition, direction is the spinning direction of the conditioning disk, and T_2 is the sweeping speed of the conditioning disk during conditioning.

18. (canceled).

19. (canceled).

20. (canceled).

21. (canceled).

22. (original): A method of developing a pad wear and pad conditioning model for

optimization of the pad conditioning for polishing pads used to remove material from a wafer, comprising the steps of:

a) determining the relationship between at least one pad conditioning parameter and wafer material removal rate; and

b) determining maximum and minimum values for each of the at least one pad conditioning parameters and the wafer material removal rate; and

c) recording the relationships and minimum and maximum values of the at least one pad conditioning parameter and the wafer removal rate.

23. (original): The method of claim 22, wherein the at least one pad conditioning parameter comprises a plurality of parameters and the wafer removal rate is defined as a weighted function of the plurality of pad conditioning parameters.

24. (currently amended): The method of claim 22, wherein the at least one pad conditioning parameter ~~parameters~~ comprises conditioning disk rotational speed.

25. (original): The method of claim 24 wherein the at least one pad conditioning parameter further comprises conditioning disk rotational direction.

26. (original): The method of claim 22, where the at least one pad conditioning parameter comprises one or more parameters selected from the group consisting of conditioning disk down force, conditioning disk rotational rate and direction, frequency and duration of conditioning, and conditioning disk translational speed.

27. (original): The method of claim 22, wherein the relationship between the at least one conditioning parameter and wafer removal rate is determined by incrementally varying the conditioning parameter and measuring the resultant wafer removal rate.

28. (original): The method of claim 22, wherein the maximum value for the conditioning parameter is the value above which no incremental increase of the wafer removal rate is observed.

29. (currently amended): The method of claim 22, wherein the minimum value for the conditioning parameter is the value ~~which~~ that provides the minimum wafer removal rate.

30. (currently amended): The method of claim 22, further comprising:

polishing a wafer in ~~the~~ a chemical mechanical polishing (CMP) apparatus under a first set of pad conditioning parameters selected to maintain wafer material removal rates within preselected minimum and maximum removal rates including conditioning disk rotational speed and direction;

determining a wafer material removal rate occurring during said polishing step; and

calculating updated pad conditioning parameters based upon said determined wafer material removal rate and the pad wear and conditioning model to maintain wafer material removal rates within the maximum and minimum removal rates. ~~; and~~

~~conditioning the polishing pad using the updated pad conditioning parameters.~~

31. (original): The method of claim 30, wherein the updated pad conditioning parameters are calculated by determining the difference between an output of the pad wear and conditioning model and said determined wafer material removal.

32. (original): The method of claim 30, wherein the updated pad conditioning parameters are updated according to the equation $k = (k_1) + g * (k - (k_1))$, where k is a measured wafer material removal rate, k_1 is a calculated wafer material removal rate, g is the estimate gain, and $(k-(k_1))$ is the prediction error.

33. (canceled).

34. (canceled).

35. (canceled).

36. (canceled).

37. (canceled).

38. (canceled).

39. (canceled).

40. (original): A method of conditioning a planarizing surface in a chemical mechanical polishing (CMP) apparatus having a polishing pad against which a wafer is positioned for removal of material therefrom and a conditioning disk is positioned for conditioning of the polishing pad, comprising the steps of:

(a) developing a pad wear and pad conditioning model that defines wafer material removal rate as a function of pad conditioning parameters by:

(i) determining the relationship between at least one pad conditioning parameter and wafer material removal rate; and

(ii) determining maximum and minimum values for each of the at least one pad conditioning parameters and the wafer material removal rate; and

(iii) recording the relationships and minimum and maximum values of the at least one pad conditioning parameter and the wafer removal rate;.

(b) polishing a wafer in the CMP apparatus under a first set of pad conditioning parameters including conditioning disk rotational speed and direction, selected to maintain wafer material removal rates within preselected minimum and maximum removal rates;

(c) determining a wafer material removal rate occurring during said polishing step; and

(d) calculating updated pad conditioning parameters based upon said determined wafer material removal rate of said step (b) and the pad wear and conditioning model to maintain wafer material removal rates within the maximum and minimum removal rates.~~, and~~

~~(f) conditioning the polishing pad using the updated conditioning parameters.~~

41. (canceled).

42. (canceled).

43. (canceled).

44. (canceled).

45. (canceled).

46. (canceled).

47. (canceled).

48. (canceled).

49. (canceled).

50. (new): A method of conditioning a planarizing surface in a chemical mechanical polishing (CMP) apparatus having a polishing pad against which a wafer is positioned for removal of material therefrom and a conditioning disk is positioned for conditioning of the polishing pad, comprising the steps of:

a) providing a pad wear and conditioning model that defines wafer material removal rate as a function of at least one pad conditioning parameter and that identifies a maximum and minimum value for each of the at least one pad conditioning parameter and the wafer removal rate;

b) polishing a wafer in the CMP apparatus under a first set of pad conditioning parameters selected to maintain wafer material removal rates within preselected minimum and maximum removal rates;

c) determining a wafer material removal rate occurring during said polishing step;

d) calculating updated pad conditioning parameters based upon said determined wafer material removal rate of said step (c) and the pad wear and conditioning model of said step (a) and

e) conditioning the polishing pad using the updated conditioning parameters.

51. (new): The method of claim 1, wherein the polishing pads is conditioned during polishing of a wafer.

52. (new): The method of claim 1, wherein the polishing pad is conditioned between between wafer polishing.

53. (new): The method of claim 1, further comprising conditioning the polishing pad using the updated conditioning parameters.